An Implementation of Power Quality Improvement of Hydro Power Generation System By Statcom

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Abstract- *This paper applicable for improving power quality by regulation of voltage and frequency of an isolated micro hydropower generation. Based on a capacitor excited synchronous generator and feeding linear load and electronic load controller. The electronic load controller based on a three phase uncontrolled diode bridge rectifier with a chopper and an auxiliary load. The complete electromechanical system is modelled and simulated in MATLAB using Simulink and simpower system block set. The simulated results are presented.*

I. INTRODUCTION

OVERVIEW

Today society is to a great extent subject to its vitality supply. Power frames the essential wellspring of vitality. Lighting, warming, cooling, correspondence, transportation, producing, handling enterprises, are all reliant on power. Financial advancement of a nation is reliant on vitality. Financial development worldwide has tripled the power utilization in the previous three decades. The essential vitality hotspot for creating power are coal, common gas, hydro and atomic parting. Every source has constraints, the fossil fills because of its restricted supply, nursery gasses, and are non- renewable sources, hydro force is subject to the precipitation for force era. New power era advances are produced to defeat the detriments of the nonrenewable sources and hydro power. Renewable vitality advances, for example, wind power, sun oriented force, tidal, geothermal is utilized for vitality era. The employments of renewable-vitality sources are expanding quickly in the late years.

INDIAN ENERGY SCENARIO

India positions fifth on the planet in complete vitality utilization. The vitality division development is significant, for the advancement of financial growth. Thermal power plants are the real supporters of power. Figure 1.1 demonstrates the Indian force era introduced limit in MW, and Table 1.1 gives the force created by different sources in rate (http://www.cea.nic.in).

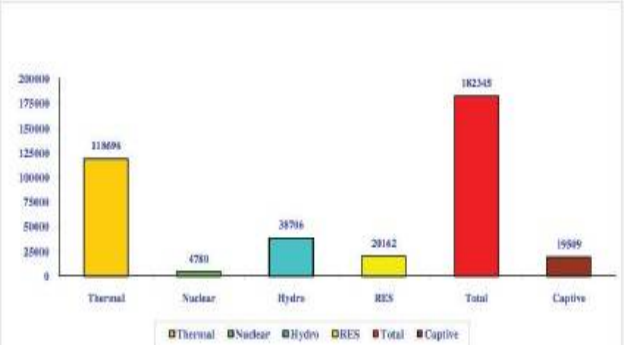

Figure 1.1 All India Power Generation Installed Capacity in MW

Table 1.1 Power Generations through Different Sources

Fuel	Percentage
Thermal	65.16
Coal	54.79
Gas	9.71
Oil	0.65
Hydro	21.18
Nuclear	2.61
Renewable Energy Sources	11.03
Total	100

HYDRO

Miniaturized scale hydro is a term utilized for hydroelectric force establishments that commonly create up to 100 kW of force. These establishments can give energy to a segregated home or little group, or are some of the time associated with electric force systems. There are a large portion of these establishments around the globe, especially in creating countries as they can give an efficient wellspring of vitality without buy of fuel.

OBJECTIVES OF PROJECT

The objectives of this project are:

i. To improvement in power quality using renewable source of energy with FACTS.
ii. To implement the use of Matlab Simulation for STATCOM
iii. To provide clean, environmentally friendly electricity in rural communities & Improve Voltage Compensation at the fault condition.

II. ELECTRIC ENERGY

CONVENTIONAL SOURCES OF ENERGY:

Coal, Petroleum (oil), and Natural Gas are the three routine sources of energy utilized as a part of warm power station to produce power. Coal is the principal heat hotspot for power era in many nations. Coal and natural gas are scorched in extensive heaters to warmth water to make steam and to produce hot burning gasses that pass specifically through a turbine, turning the blades of the turbine to create power. Petroleum can likewise be utilized to make steam to turn a turbine. Lingering fuel oil, an item refined from unrefined petroleum, is regularly the petroleum item utilized as a part of electric plants that utilization petroleum to make steam. The introduced limit of Thermal Power in India, as of June 30 2011, was 115649.48 M which is 65.34% of aggregate introduced limit.

Power Quality (PQ)

Power Quality (PQ) is characterized as any force issue showed in voltage, current, or recurrence deviations that outcome in disappointment or mis operation of utility or end client gear. With huge modern organizations including new advancements and touchy electronic gear to their operations, PQ issues have turned out to be more vital than any other time in recent memory. Hydro One reacts to our clients' needs with a Power Quality Inquiry Reporting Process. Since the transmission framework is interconnected, sometimes, one client's hardware can unfavorably influence the nature of electrical supply to another client. For instance, extensive engines, curve heaters, countless straight loads, for example, variable velocity drives, or power component amendment capacitors, would all be able to add to power quality unsettling influences. It's likewise conceivable that typical exchanging on Hydro One's system hardware may antagonistically influence our clients.

2.3.Methodology

The execution of power area in India is investigated with the assistance of chose non-money related and budgetary pointers. Non money related markers are per capita vitality utilization, utilization per capita, introduced limit, gross era, influence buy, deals, T&D Losses, number of buyers. Money related markers are complete expense and income, net deficiency/surplus and working shortfall/excess, normal cost and tax, cost recuperation proportion, working proportion, net benefit rati , working benefit proportion, quantifiable profit and profit for capital utilized.

III. RESULTS & DISCUSSIONS

The name MATLAB stays for Matrix Laboratory. MATLAB is an item package for tip top numerical figuring and observation. It outfits a natural space with a few characteristic limits for particular computation, outline and activities. The mix of examination limits, flexibility, steadfast quality and extraordinary representation makes MATLAB the head programming pack for electrical designers. Best of all, MATLAB gives basic extensibility its own specific anomalous state programming vernacular. MATLAB gives a smart circumstance a few strong and exact characteristic logical limits; these understood limits give great machine to straight polynomial math counts, data examination, flag taking care of, streamlining, numerical plan of ODEs, quadrature and various distinctive sorts of exploratory figuring's. They give answers for a wide extent of numerical issue including structure variable based math and complex calculating. There are moreover different an outside interface to run programs written in FORTAN or C vernacular from MATLAB.TYPICAL USES OF MATLAB

1. Math and figuring
2. Figuring headway.
3. Illustrating, diversion and prototyping.
4. Data examination, examination and representation.
5. Investigative and planning representation
6. Application progression including graphical UI.

INTRODUCTION TO SIMPOWER SYSTEMS:

Sim Power Systems and distinctive after-effects of the Physical Modelling thing family coordinate with Simulink to show electrical, mechanical, and control structures Sim Power Systems works in the Simulink environment. Control systems are blends of electrical circuits and electromechanical contraptions like motors and generators. Engineers working in a specific order are constantly improving the execution of the systems. Necessities for certainly extended efficiency have obliged drive structure fashioners to use control electronic devices and refined control system thoughts that evaluation standard examination mechanical assemblies and strategies.

USED PARAMETERS

I:SG parameter for smaller scale hydro power framework

S.N	PARAMETER	RATING
1	POWER	250KVA
2	FREQUENCY	50HZ
3	VOLTAGE	11kV
4	SPEED	1500RPM
5	Rs	0.0259375
6	Xd	2.84
7	Xd'	0.18
8	Xd''	0.13
9	Xq	2.44
10	xq''	0.36
11	Xl	0.09
12	Td'	0.08
13	Td''	0.019
14	Tq''	0.019

Synchronous connection reactor Rf=0.44 Ω, Lf=7.25mH
Statcom Cdc= 375µF, PI controller
Recurrence controller, Kf = .22, Ki = 10

The parallel operation of disengaged offbeat generators execution is exhibited with adjusted/lopsided, direct and non straight loads. The capacity of battery is accomplished for burden leveling and a consistent force is kept up at generator terminals. The proposed system is modelled and simulated using MATLAB environment. The configuration includes the -hydro turbine, synchronous generator, a back-to-back AC-DC-AC converter, SG (250kVA), power quality analyzer, RL-load with 3 Mvar capacity Statcom connected through it. The linear load applied for simulation time 2 sec, then the load observed high power requirement so the battery supplies additional power required by consumer loads. The function of battery is achieved for load leveling and a constant power is maintained at generator terminals.

Maturing full load is expelled at 2sec, the battery begins charging by the all created power. So thusly the battery charging and releasing furthermore his controller keeps the produced power steady and enhanced force quality by keeping up terminal voltage and frequency.(fig 2 to 3)

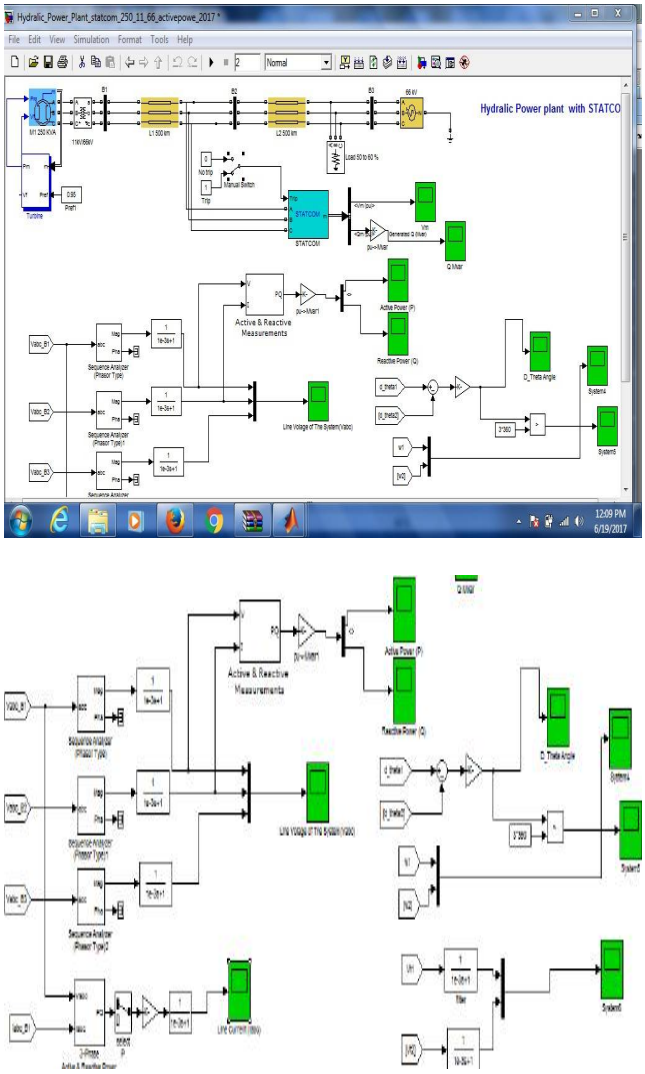

Fig 2. Simulink Model for Hydro Power plant

3.3. SIMULATIONS AND RESULT

In the fig 3.we can see that at the simulation time .055 sec fault is occurred in the system in the existing thing . STATCOM when incorporated in the system it try to maintain the fault at .055 sec at the 2.1 pu for the three phase line voltage .

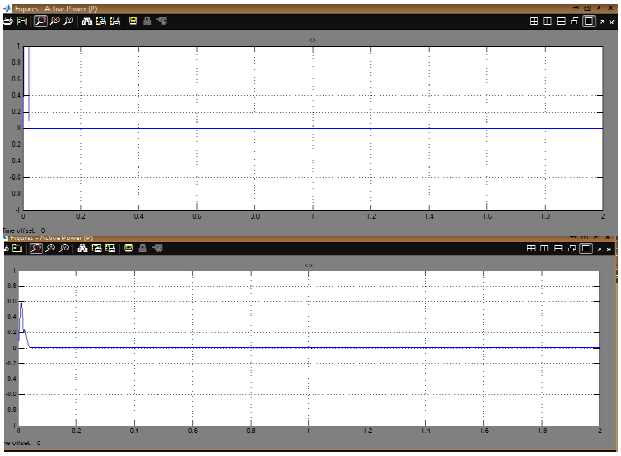

Fig 3. (A)Bus Active power of hydro plant with and Without STATCOM Respectively

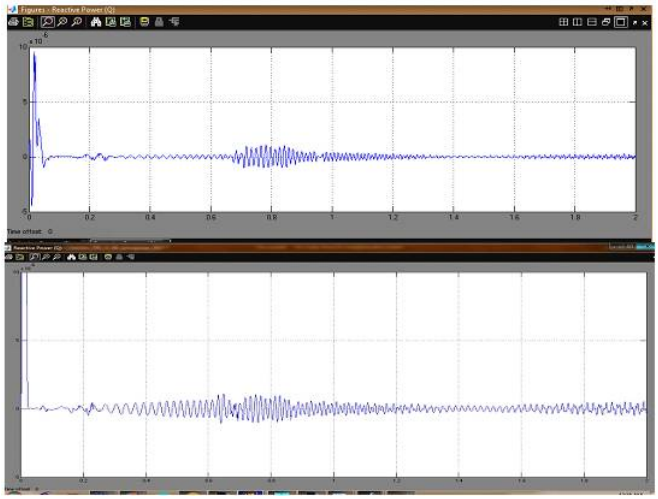

Fig 3(B) Bus reactive power of hydro plant utilizing with and without STATCOM Respectively

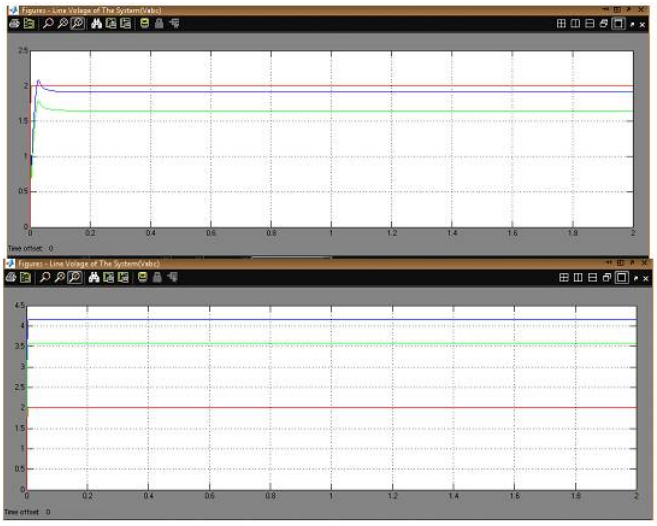

Fig 3 (c) Bus line voltage of hydro plant utilizing with and without STATCOM Respectively

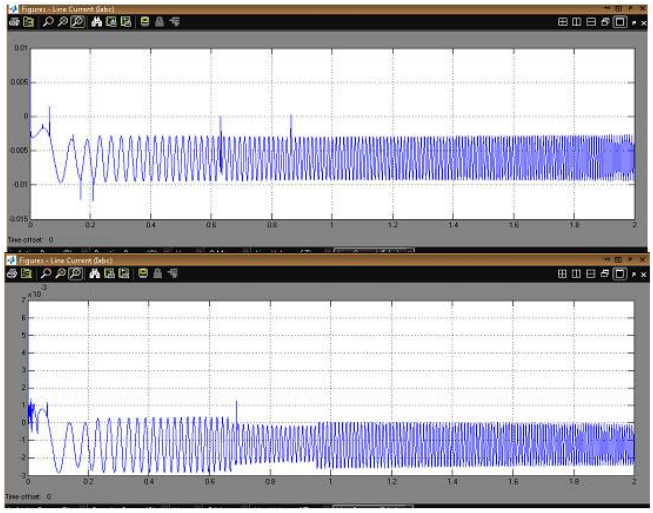

Fig 3 (d) Bus Current Iabc of hydro system with and without STATCOM

The bus current will be same as suppose we incorporated STATCOM in the system , it will not effect to bus line current in the system.

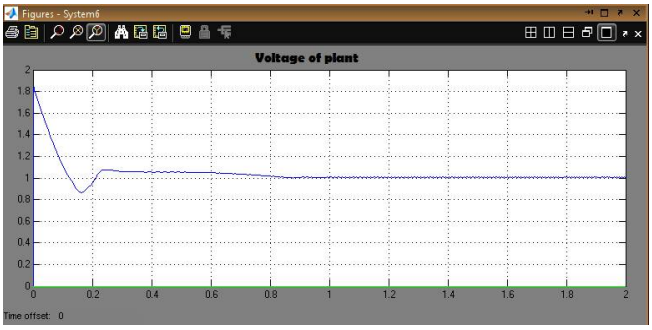

Fig 4 Reference Filter Voltage Excitation

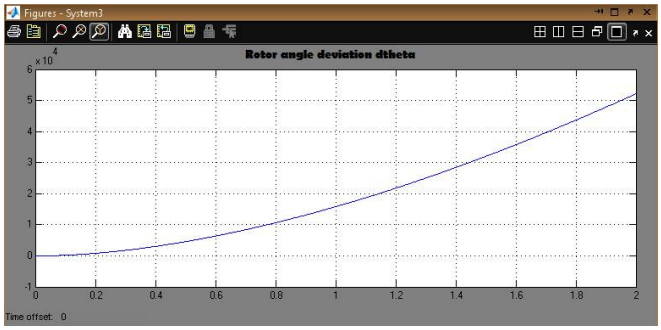

Fig 5 Rotor Angle Deviation of Hydro system

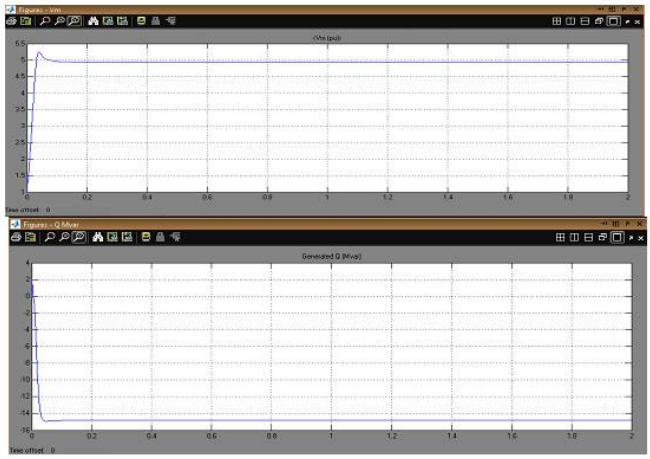

Fig 6 Voltage Output of STATCOM and Generated Reactive Power connected with STATCOM

IV. CONCLUSION

we have already discussed about the hydro system with using the FACTS device & without the FACTS device. we having the number of facts device available for the power quality improvement. A Statcom is proposed in a position of a customary which depends on vector control plan including synchronously pivoting do reference. As Statcom is intended for solidarity power. A battery is associated on the dc side which is charged and released by the bidirectional movement of Statcom. The Statcom likewise performs different capacities like voltage direction, & reactive power control & provide better result for the voltage compensation & reactive power control This paper revealing the hydro system to reached at steady state by use of facts device statcom at the simulated scale .055 sec for the under simulated time 2 sec. showing the reactive power at the faulty condition . The paper mainly focuses on uncontrolled hydro turbine feeding a single load. A Statcom is proposed in a place which is based on Matlab simulation involving synchronously rotating dq reference. As Statcom is designed for unity power. A battery is connected on the dc side which is charged and discharged by the bidirectional activity of Statcom. This action helps to keep the frequency constant which is very critical in an isolated grid. The Statcom also performs other functions like voltage regulation, harmonic elimination and neutral current compensation. and by the use of Statcom system can reached to steady stat condition by the under simulated time and power quality will be improved.

V. FUTURE SCOPE

There are number of Plant is running for the electricity generation and using the FCATS device , in future also we can use the different FACTS device comparison purpose only for hydro power plant.

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